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United States
Department of
Agriculture

Forest
Service

Miscellaneous
Publication
Number 1440

Your Nation's Timber

Problems and Opportunities

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Preface

You plant a walnut today for your grandchildren to harvest. This aphorism emphasizes the critical dilemma of forest resource planning. Fine walnut may take over a hundred years to mature. Pine seedlings planted in 1980 can furnish the wood-pulp for your newspaper in 2010.

Recognizing this, the Congress has for more than a century directed Federal agencies to prepare longrun analyses of the Nation's timber situation. The newest of these, *An Analysis of the Timber Situation in the United States, 1952-2030* and *America's Renewable Resources: A Supplement to the 1979 Assessment of the Forest and Range Land Situation in the United States* look back some three decades and forward five decades to changes that may be taking place.

These analyses present information essential

for the development and guidance of forest policies and programs. Decisions based on this information will, in one way or another, affect the quality of life for everyone in our society.

The major highlights of these studies are set out briefly in the pages that follow.

Readers desiring a detailed discussion can obtain the source documents from the Forest Service, U.S. Department of Agriculture, P.O. Box 2417, Washington, DC 20013.

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A Resource in Demand

The first-wave Yankees, and the second and third . . . had every use for trees. Buckets and bedsteads. Cribs and cabins, candlesticks and coffins. Ash for their oars, pine for their mainmasts, maple for gunstocks, hornbeam for handles. They used it all, and well . . .

-- John G. Mitchell
Audubon, March 1981

As American pioneers moved westward, broad-ax in hand, they took trees freely from the continent's seemingly limitless forest resource. Charcoal burners followed, furnishing fuel for the colony's foundries and forges. Cordwood cutters piled their ricks on river banks to fire the boilers of the sternwheelers. And wooden bridges, railroad ties, and telegraph poles

carried the Nation's commercial arteries from coast to coast.

Although the Nation's factories turned more and more to iron, steel, plastics, and other raw materials, and its homes to fuel oil, gas, and electricity, the demand for wood continues. Today, timber comprises about a quarter of all

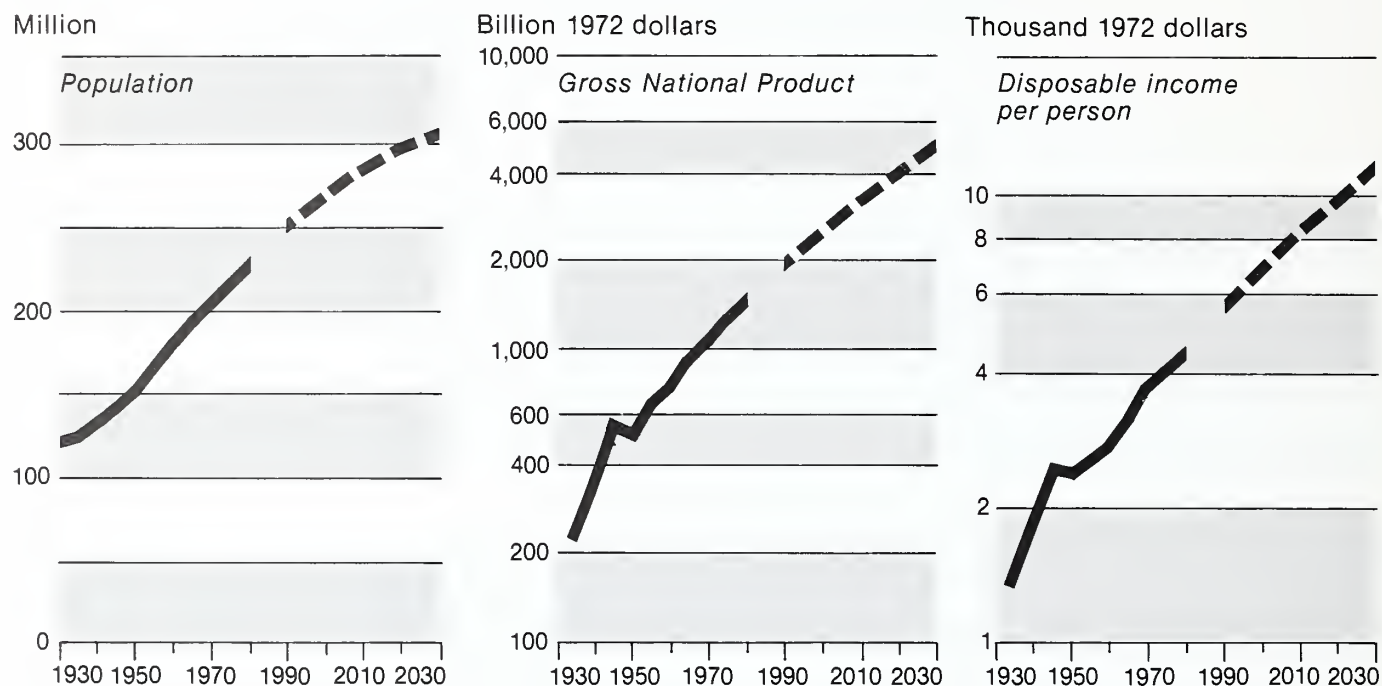


For a long time timber was the Nation's most important raw material. It was used for homes, for fuel, for roads, for bridges--and timber is still important; it is the source of

about a quarter of all the raw material consumed in the country and of heat in millions of homes.

Figure 1

Population and Economic Growth



the industrial raw materials consumed in the country. It is used as a source of heat in millions of homes and by the forest industries as a source of energy. It supports the economies of many areas, provides jobs for millions of workers, and contributes to the quality of life for everyone, now as in times past.

As the population grew and economic activity expanded, the consumption of most timber products increased. Between 1950 and the late 1970's, which brings us into the timespan of the current analyses, the use of softwood lumber rose 21 percent, hardwood plywood 185 percent, pulpwood (the wood used in making paper) 177 percent, and softwood plywood 595 percent.

Past trends for fuelwood are somewhat different. Use of fuelwood declined through the mid-1970's. Since then, consumption has moved up rapidly in response to the increasing costs

of oil and natural gas: in 1980 it was 3 billion cubic feet, five times the 0.6 billion cubic feet consumed in 1976.

Demands for most timber products are projected to continue to rise over the next five decades. This reflects expected growth in population, economic activity, and income.

In the past 50 years, the Nation's population climbed from 123 million to 230 million (fig. 1). The latest Bureau of the Census estimates show population continuing to grow, rising to 304 million by 2030.

Economic activity, as measured by the gross national product, quadrupled between 1929 and 1978. It is expected to nearly quadruple again by 2030.

The income available for spending is also projected to be nearly four times higher by

2030; each person's disposable income will grow by almost three times.

Of course, what actually happens may differ greatly from these expectations. However, they are consistent with our society's goals of full employment, continued economic growth, and rising incomes.

Looked at in another way, these projections of population, economic activity, and income are measures of the job ahead, meeting the timber demands of another 75 million people and satisfying the needs of a population of over 300 million with much greater purchasing power.

In response to these needs, and as illustrated in figure 2, the demand for all of the major timber products is expected to grow over the next 50 years. Demand for some products is expected to rise more rapidly than for others.

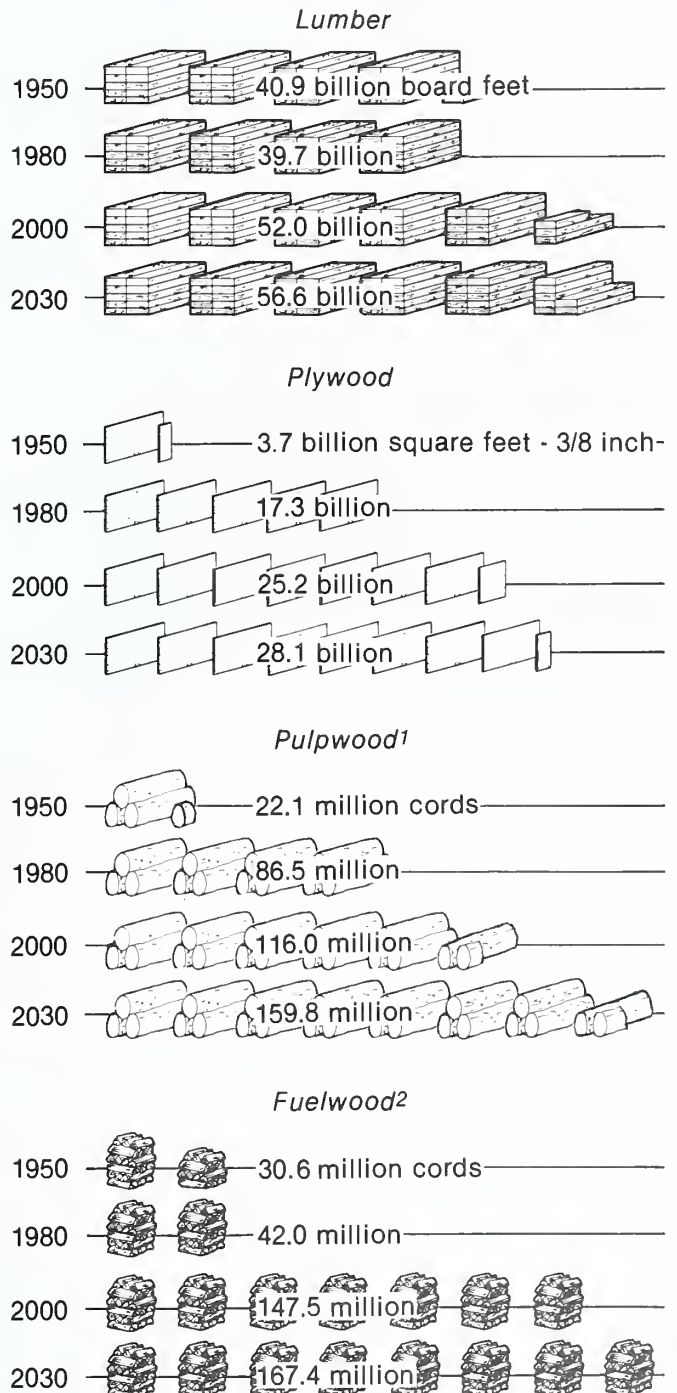
These demands in figure 2 are shown in units standard for the various products--board feet of lumber, square feet of plywood, cords of pulpwood. In order to estimate total timber demand and facilitate comparisons with timber supplies, these standard unit volumes must be converted to a common unit: cubic feet, roundwood equivalent; that is, the volume of logs and other roundwood needed to produce the various products.

The projected demands for roundwood, after all product volumes are converted to cubic feet and added together, are shown in the table on the next page.

As these data show, much of the growth in softwood timber demands takes place in the next decade. This reflects an expected surge in home building as the large numbers of people born during the "baby boom" years of the 1950's and 1960's seek their own place to live. Pent-up needs resulting from recent low levels of housing construction may further increase timber demands in the late 1980's and 1990's. Such building is now the largest source of demand for softwood lumber and plywood.

Figure 2

Timber Products Consumption and Projected Demand



¹ In U.S. mills. ² Roundwood only.



Much of the projected growth in timber demands is expected to take place in the last half of the 1980's and early 1990's in

response to a surge in home building and increased use of wood in domestic heating.

<u>Year</u>	<u>Softwoods</u>	<u>Hardwoods</u>	<u>Total</u>
	(Billion cubic feet, roundwood equivalent)		
1970	9.5	3.0	12.5
1980	10.7	5.0	15.7
	<u>Projections</u>		
1990	12.0	6.0	18.0
2000	12.8	7.6	20.4
2010	14.0	9.1	23.1
2020	15.0	10.3	25.3
2030	15.1	10.7	25.8

Note: Data exclude projections of fuelwood demands on nongrowing stock resources such as tree tops, limbs, and bark; trees under 5 inches in diameter at breast height; and trees on noncommercial forest lands, in fence rows and in urban areas.

Beyond the 1980's, demands continue to rise and by 2030 are more than double consumption in 1976. Most of the growth beyond the 1980's is for pulpwood, a response to increases in demands for products made from woodpulp, such as paper and paperboard boxes, and for fuelwood.

Over the past 20 years nearly all the increase in timber demands has been for softwoods--pines, firs, hemlocks, and other coniferous trees. On the other hand, the consumption of hardwoods--oaks, hickories, maples, gums, yellow-poplar, and other deciduous trees--has remained about the same as in the late 1950's.

Past patterns of consumption are projected to change as demands for both softwoods and hardwoods increase in coming decades. Demand for softwoods goes up from nearly 11 billion cubic feet to over 15 billion. Demand

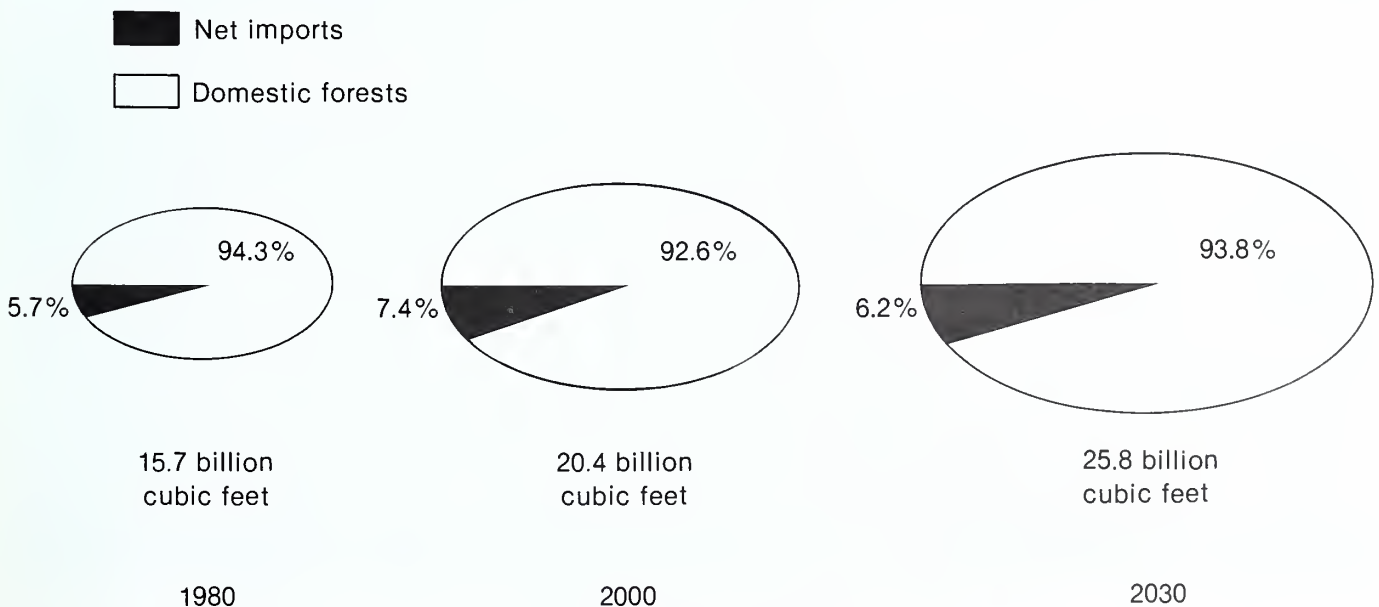
for hardwoods more than doubles, rising from 5 to 10.7 billion cubic feet. The faster growth in hardwood demand largely reflects that wood's increasing use for pulpwood; fuelwood; and products such as pallets, railroad ties, and to a lesser extent, furniture.

Consumption of sawtimber--the larger size timber that is measured in board feet and used mostly for producing lumber and plywood--has followed the same general trends as for roundwood. Projections show this pattern continuing.

Timber products imported from other countries have filled part of our domestic needs (fig. 3). Since 1950, the Nation's timber product imports have doubled, rising to over 3 billion cubic feet, roundwood equivalent. The most important softwood products are lumber, woodpulp, and newsprint; plywood and veneer are the most important hardwood products.

Figure 3

Source of Timber Products Supplies



Imports continue to rise until about 2010, then level off at about 3.9 billion cubic feet.

U.S. timber product exports, chiefly pulpwood products and softwood logs and lumber, have also increased over the years. This reflects rising demands in Western Europe, Japan, and most other countries around the globe.

World demands for most timber products are expected to continue to rise; however, U.S. shipments of the major products are likely to show divergent trends. Exports of softwood logs and lumber are projected to stay close to present levels until 1990 and then begin to decline. This in part reflects an expected fall-off in residential construction in Japan. Wood-pulp and paper and board exports are projected to continue up. When all products are combined, the total volume of exports does not change much over the next half century.

Given the above trends, net imports--total imports minus total exports--will increase by 700 million cubic feet between 1980 and 2030. This will satisfy part of the higher timber demands projected for the future. However, the growth in net imports is small compared with the projected expansion in timber demands. Thus, domestic forests must meet most of the increased needs.

Demand on domestic forests is projected to rise by over half in the next 50 years--going up from nearly 15 billion cubic feet in 1980 to close to 24 billion in 2030. And demand for sawtimber, the larger roundwood, is expected to show a similar increase. The projected growth is much the same for softwoods and hardwoods.

Slowly Growing Supplies

Paul Bunyan strode across the United States, leading legions of lumberjacks, their axes and saws, calked boots and stagged britches. They logged the maples from beyond Presque Isle. They harvested the chestnut groves along the Susquehanna. And they guided white pines down the roaring Saginaw. When Promontory's spike linked the continent, they were cutting the Sierra slopes. As the century ended, they were clearing the Southland cypress from river bottoms, pines from Arkansas and Louisiana. Great harvests were taken for building, manufacturing, fuel.

When the first settlers arrived, forests covered nearly half of the country. Now about a third of the country is forested. Not all of this area (737 million acres) can provide harvestable timber, however. Some areas are too high, too steep, or too rough for harvest.

Others are too barren, too wet, or too arid to produce a commercial crop of timber. And, of course, some are in wilderness, parks, and other areas reserved by statute from being harvested.



When the first settlers arrived, forests covered nearly half of the country. Forests still cover about a third including over 480 million acres available and suitable for timber production.

Nearly two-thirds of the present forest area--some 480 million acres--is available and suitable for timber production. Each of these acres can produce at least 20 cubic feet of wood fiber each year and is classified as "commercial" timberland.

Farmers and other private owners--housewives, doctors, lawyers, and companies not in the forest industry--hold 58 percent of the country's commercial timberland. Forest industry firms own about 14 percent.

Nineteen percent of the commercial timberland belongs to the public and is in National Forests. Another 9 percent is also publicly owned but administered by other Federal agencies and State, county, and municipal governments.

The country's commercial timberlands contain almost 800 billion cubic feet of roundwood. About nine-tenths of this is growing stock, live trees 5 inches and larger in diameter. And most of this growing stock is in sawtimber, trees big enough to contain at least one log suitable for lumber manufacture. Poletimber, trees at least 5 inches in diameter but less than sawtimber size, account for the rest.

The remaining tenth of the total roundwood volume is in rough, rotten, and salvable dead trees. Although a little of this is suitable for making lumber and veneer, most is usable only for pulp, fuel, and other products.

Softwoods (coniferous species) predominate in the Nation's growing-stock inventory, comprising nearly two-thirds of the total--456 billion cubic feet. Most of this volume--some 368 billion cubic feet--is in sawtimber.

Nearly half of the softwood growing stock, and over half the sawtimber, is on the National Forests, mostly in western old-growth stands. A little over a fourth of the softwood growing stock (about a fifth of the sawtimber) is on farmer and other private ownerships, primarily in the East. The rest is on forest industry land, largely in the West.

Total hardwood growing stock inventories amount to more than 255 billion cubic feet, including 137 billion cubic feet of sawtimber. Over two-thirds of these volumes are in forests on farmer and other private ownerships; forest industries own more than a tenth. The remaining hardwood volumes, a little less than a fifth of the total, is in public ownership. The bulk of the hardwood timber in private ownerships is in the East, about equally divided between the North and the South.

The domestic timber situation has improved in recent decades. Softwood growing stock inventories rose 7 percent between 1952 and 1977, from 425 billion cubic feet to 456 billion. Hardwood inventories rose 43 percent from 178 to 255 billion cubic feet. Sawtimber inventories followed similar trends.

Rising inventories result when additions in the form of net annual growth (total growth less mortality) are greater than the volumes removed by harvesting, clearing, or changing land use.

Net annual growth of all softwood growing stock exceeds removals by more than 50 percent in the East. Net annual growth of eastern hardwoods also substantially exceeds removals, especially in the North. For all of the East, net annual growth of hardwood growing stock is more than double removals.

In contrast to the East, softwood inventories in the West declined between 1952 and 1977, largely as a result of removals exceeding growth on the National Forests and forest industry ownerships on the Pacific Coast. Such growth removal balances and inventory declines are a natural consequence of harvesting the old-growth stands in the region. Net annual growth in such stands is low. Once harvested, however, the lands have the capacity to grow large volumes of timber.

For the West, softwood sawtimber removals exceeded net annual growth by 8 billion board feet in 1976. All of this was on the Pacific Coast. The Rocky Mountain Region has had a



Softwoods or coniferous species predominate in the Nation's forests, about two-thirds of the growing stock inventory. Nearly half of this timber is in the forests in the Pacific Coast States.

favorable growth removal balance but inventories have increased slowly because many of the stands are old stands where net annual growth is low.

At the present time most forest regions can support larger timber harvests. If commercial timberland owners continue responding to price and inventory changes and practice forest management as much as they have in the recent past, annual supplies (the amount of timber available for harvest each year) of softwood roundwood will rise almost a third, from a 1976 total of 9.5 billion cubic feet to 11.9 billion in 2030. During the same years, softwood sawtimber supplies available for har-

vest each year are expected to increase but by smaller amounts.

There are important differences in the outlook among major softwood timber producing regions. For example, on the Pacific Coast, the volume of softwood timber available for harvest is not expected to change much in the next few decades. As indicated in a following chapter, there are opportunities to increase harvests in this section, largely by intensifying management and accelerating harvests on the old-growth stands on the National Forests.

Projected softwood timber supplies in the South show a sizable gain--about 75 percent--



Most forest regions can support higher levels of timber harvests. The largest potential for increasing softwood timber harvests is in the pine forests of the South.

between 1976 and 2030. Small increases are also projected for the North and Rocky Mountains.

Projected hardwood roundwood supplies will almost triple in the 1976-2030 period, and hardwood sawtimber supplies more than double. Nearly all of the increase in hardwood supplies will come from farmer and other private ownerships, with those in the South showing the largest rise.

Changes in timber supplies of the amounts projected are sure to have major and long-lasting effects on the economies of the forested regions. On the Pacific Coast, there are likely to be fewer jobs and reduced income from timber unless action is taken to increase harvest levels. In the South, on the other hand, and to a lesser extent in the North and Rocky Mountains, the timber resource can support additional timber based activity and associated gains in payrolls and employment.

Enough Timber — At What Price?

In Somalia, a woman may walk till noon to collect enough wood to warm her children that night. By dusk, she reaches home again, lights some sticks to cook food for her family and later to warm them as they sleep in the cold desert. Tomorrow, she will go out again. And the next day. The few sticks she takes are more than the land can replenish. Sand creeps up; the trees recede. Her daughter may walk until dusk to reach the woods.

We will not face timber supply problems so severe in the foreseeable future. During the next half century, though, timber demands are projected to rise faster than supplies. The probable consequences of this are economic scarcity and rising real (net of inflation or deflation) stumpage and timber product prices, and increased real costs for producers and consumers of wood products (fig. 4).

The prospective timber demand-supply-price situation varies by species, quality, size, and region. The problem is most severe for softwoods. Softwood roundwood demand is expected to reach almost 14 billion cubic feet by 2030; supplies will likely increase to a little less than 12 billion cubic feet. Prospects for softwood sawtimber are similar: large increases in demands, modest increases in supplies.

This outlook means that prices of softwood timber will rise to balance softwood demands and supplies in future decades. For example, in the South the real price for softwood stumpage (trees standing in the forest) will go up at a rate of about 2.1 percent a year during the next five decades. In the Douglas-fir sub-region of the Pacific Northwest, real prices rise more slowly, at an average rate of about 1.4 percent annually.

Projections of hardwood supplies and demands indicate that supplies most likely will be able to meet demands for the next two or three decades. Thus, average hardwood stumpage prices remain fairly steady until demands begin to outstrip supplies after 2000. At that time, prices begin moving upward, especially

in the North-central region, where competition for available supplies will probably be most intense in response to large increases in fuelwood demands.

During recent decades, removals of certain preferred hardwood species--such as select white and red oak, walnut, hard maple, and black cherry--have been close to or above net annual growth. The rapid increases in stumpage prices for these species have reflected this situation. These increases seem likely to continue under projected demand-supply conditions.

As prices for stumpage go up, the prices of products made from it will also increase. For example, real softwood lumber prices are projected to go up at an annual rate of just over 1.3 percent a year during the next five decades. Hardwood lumber prices increase at slightly less than 1 percent a year. Consumer incomes will rise at roughly comparable rates.

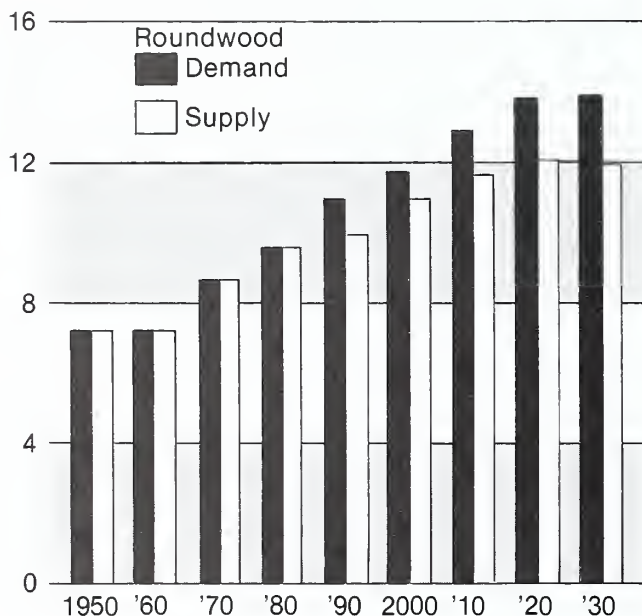
Although the future is always dimly seen, it seems reasonably certain that the Nation is faced with the prospect of continuing and substantial real increases in stumpage prices for most species and sizes of timber, and in the prices of most timber products. And they will very likely be largest for softwood sawtimber; higher quality hardwood sawtimber of preferred species; and the products, mainly lumber and plywood, made from this timber. The increases for softwood timber and timber products are also likely to be largest in the next decade or so as the expected increases in home building cause a surge in demand.

Figure 4

Softwood Roundwood and Products

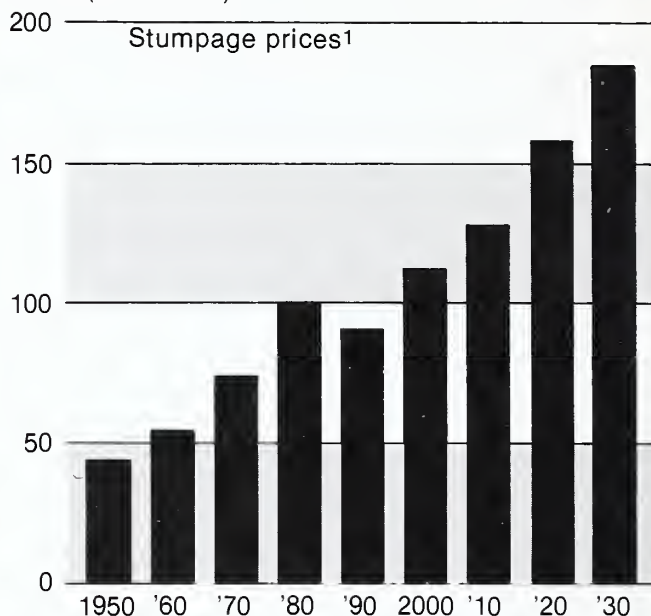
When demands exceed supplies ...

Billion cubic feet



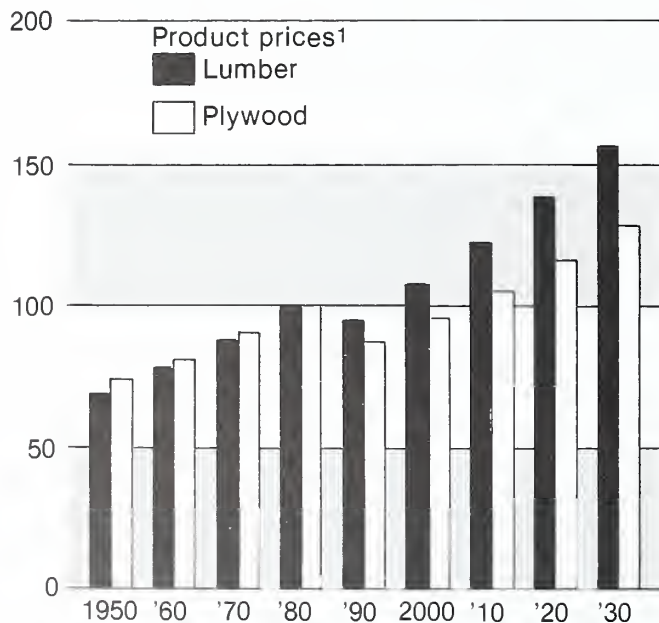
... stumpage prices increase and ...

Index (1980 = 100)



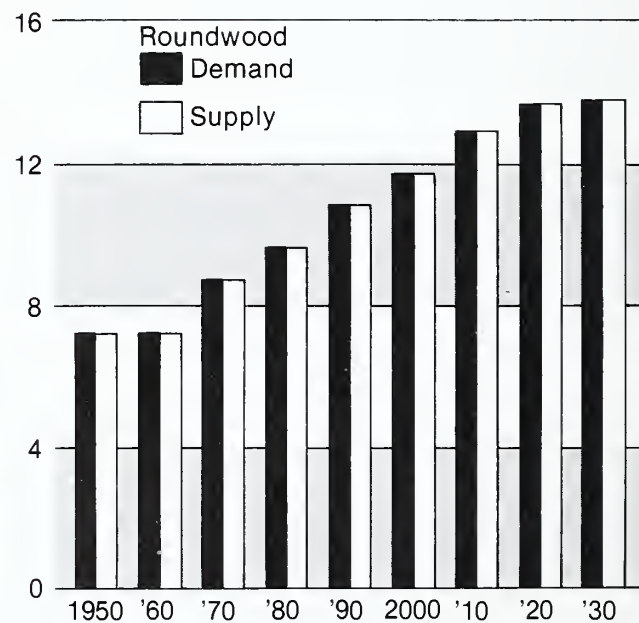
... product prices rise ...

Index (1980 = 100)



... until demands and supplies equalize

Billion cubic feet



¹ Net of inflation or deflation.

Rising Timber Prices — The Cost

In a science fiction story created some 25 years ago, the central character flaunted a ring more precious than one of diamonds and gold--a circlet of oak. In life, no wood has yet attained such value, and it is not expected to in the future. As the economic scarcity of timber grows, however, the quality of life in the United States will be affected. Higher real prices--for standing timber and for timber products--will adversely influence the Nation's economy and environment and social well-being.

Timber products consumers--and this includes everyone in our society--will be affected by rising real prices. Given the projected increases, by 2030 they will pay several billion dollars more for the timber products and substitute materials needed to produce the goods they will consume than they would if timber supplies were large enough to keep prices stable. Prospective home buyers will be most affected. For example, the projected real increases in softwood lumber prices by 2030 will cause a significant reduction in housing construction below the levels that otherwise would be built. These increases will also adversely affect the size and quality of the units that are built.

As stumpage and timber product prices rise, use of substitute materials such as concrete, steel, aluminum, and plastic will increase. And as production of these substitutes is stepped up, more and more nonrenewable resources, including the ore and fossil fuels used in their production, will be removed from the country's finite store of these materials.

In addition, the mining, industrial processing, and power generation associated with increased use of timber substitutes will result in more air and water pollution. Thus, as timber prices go up, environmental costs to control the additional pollution will also rise.

Since the timber sector operates in a free competitive economy, as prices move up, the demands for timber and timber products are reduced--consumers simply use less.

Lumber production with the price increases will still rise and stand at high levels through the projection period. However, by 2030, lumber production will be several billion board feet below the volume that would exist without the real price increases. Thus, the potential for growth and for sharing in the benefits of the larger markets by the lumber industries will be severely constrained.

Exports of most timber products are determined largely by the capability of U.S. producers to compete on a price basis with



Rising prices for standing timber products will adversely influence the economy, the environment, and social well-being. They will constrain home building and cause a reduction in the size and quality of the units that are built; they will result in more air and water pollution; they will reduce the potential for growth in the timber processing industries.

producers in other countries. Consequently, rising prices will also constrain the country's timber export potential.

Lower demands in domestic and export markets will affect employment. Employment in the timber industries in 2030 will be below the levels that would exist without the real price increases. Since losses in one industry affect many related service jobs, these changes could eventually impact a quarter million workers throughout the economy. Equally critical, these losses will hit hardest the forested areas in rural communities which are chronically burdened with high unemployment. The losses of timber-based employment would be offset in part by additional employment in other industries.

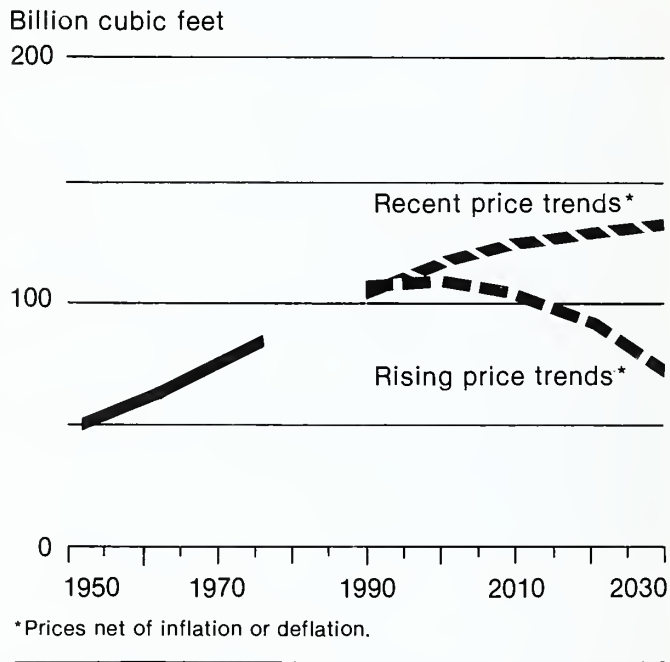
Rising real prices will also affect timber supplies. Owners will increase harvests as prices go up and, as harvests rise, net annual growth and inventories will be changed. The largest impacts will be on forests in the South. By 2030, for example, softwood growing-stock inventories on private ownerships in this section will be 45 percent below that projected without rising real prices (fig. 5). Inventories on the Pacific Coast also would be reduced.

For many parts of the South and other forested areas, such changes in the timber resource will mean that recent and prospective growth in employment and output by the forest industries will last only a few decades and be followed by a sharp decline.

Rising prices will have positive effects; they will induce more forest owners to invest in management practices which will increase timber supplies. This will, in time, offset part of the projected decline.

Figure 5

Softwood Roundwood Inventories on Private Ownerships in the South



More From The Forest

At New College of Oxford University, founded in the late sixteenth century, the great dining hall was spanned by oak beams some 20 inches on a side, 30 feet long. Recently the college council was dismayed to learn that those beams had been damaged by beetles. Where would they find timbers of such size, such strength to replace the four-century old beams? They asked the college forester whether any suitable trees might be found on the college preserves. "Well, sirs," he is supposed to have answered, "we was wonderin' when you'd be askin'." The council then discovered that when the college was established, a grove of oaks had been planted so that the timbers to replace the dining hall beams would be available when needed.

Only 200 years ago, the Nation's forests seemed limitless. Today, it is clear that problems are ahead which must be faced and solved if rising timber prices are not to adversely affect the society, the economy, and the environment.

Standing timber and timber products need not become more costly. The impacts of economic scarcity are not inevitable. Given enough time, several decades, there are opportunities to greatly increase and extend timber supplies. There are also opportunities to respond to the surge in demand for softwood timber expected in the late 1980's and early 1990's.

By the mid-1980's, timber harvests can be accelerated on National Forests in Washington, Oregon, northern California, northern Idaho, and western Montana, which have large inventories of old-growth softwood timber. Although volumes cannot be determined until management plans are developed and approved for each individual Forest,^{1/} it is estimated that with adequate funding for sales preparation, road construction, and the protection of

^{1/}Under the provisions of the National Forest Management Act, accelerated harvests that depart from nondeclining evenflow on the National Forests can only be determined and implemented after approved management plans are developed for each individual National Forest.



Only 200 years ago the Nation's forests seemed to stretch without end across the continent. Today, it is clear that problems lie ahead which must be faced and solved if rising timber prices are not to adversely affect the society, the economy, and the environment. And this can be done.

the environment, harvests could be raised substantially. In addition, there is a potential for increased salvage of rough and rotten trees, dead trees, and logging residues.

The increase in supplies would contribute to meeting the jump in demand for softwood timber expected later in the 1980's and reduce upward pressure on prices. However, sustaining the higher harvest levels on the National Forests beyond two or three decades or so would require accelerated investments in more intensive management programs.

Southern pine forests in private ownership in the South can support bigger harvests in the 1980's and 1990's. But here again, large investments in regeneration of harvested softwood stands and related management programs will be necessary to sustain the higher levels of output much beyond the year 2000.

In the longer run, there are opportunities to meet all the projected increases in timber demands and to greatly increase timber exports. As shown in the tabulation on page 21, current net annual timber growth is only about two-thirds of what could be attained in fully stocked natural stands.

With the use of genetically improved trees, fertilization, spacing control, and other intensive management measures, much greater growth than is shown in this tabulation can be achieved.

Of course, not all of these biological opportunities can be expected to yield an acceptable rate of return on the investments necessary to put them into practice. Even so, there are many economic opportunities to increase supplies and these would yield 4 percent or more real return (net of inflation or deflation) on the investments.

Such opportunities exist on 124 million acres of timberland in farmer and other private ownerships--about a quarter of the Nation's total. If used, they would increase net annual growth by over 9 billion cubic feet, a volume

roughly equal to the total softwood timber harvest in 1976.

Economic opportunities to increase timber supplies also exist on 34 million acres of timberland in forest industry ownership. Use of these opportunities would increase net annual timber growth by nearly 3 billion cubic feet.

The bulk of the opportunities on private ownerships consist of regeneration of nonstocked acres, harvesting and regeneration in mature timber stands, and conversion of existing timber stands to more desired species.



Standing timber need not become more costly. There are many opportunities to increase and extend supplies--timber harvests can be accelerated on National Forests with large inventories of old-growth softwood timber.

Although there are private timberlands with economic opportunities for increasing timber growth in all parts of the country, southern

<u>Ownership</u>	<u>Current net annual growth</u>	<u>Potential net annual^{1/} growth in 2030</u>
<u>(Billion cubic feet)</u>		
National Forest	3.1	5.8
Other public	2.0	2.9
Forest industry	4.1	6.3
Farmer and other private	<u>12.5</u>	<u>17.8</u>
Total	21.7	32.8

^{1/}Net annual growth attainable in fully stocked natural stands on the projected areas of commercial timberland in 2030.

forests contain the largest areas--about 113 million acres.

Although the management plans are not complete, it is clear that there are also substantial economic opportunities on the National Forests. Most of these opportunities, chiefly harvest and regeneration of mature stands, are likely to be on the western forests with large inventories of old-growth softwood timber. The harvest and regeneration of these mature stands would, of course, increase growth on the National Forests.

Improved utilization is another important way to meet part of the growth in demands for timber products.

More than a billion cubic feet of wood residues are now left after harvests on logging sites. Perhaps two to four times as much is left in treetops and branches, rough and rotten trees, small stems, and other unused material. There are also large volumes of salvable dead timber; trees in chaparral, pinyon-juniper, and other low productivity forests; and urban wood wastes. Although most of this material is not suitable for manufacturing solid wood products, some of it is usable for products such as woodpulp, particleboard, and fuel.

Improved processing efficiency in the lumber, plywood, and pulp and paper industries could increase the yields of these products. For example, careful monitoring of sawmilling processes, lumber drying, and remanufacturing could contribute to greater output. More attention to equipment maintenance and machine settings could increase lumber yields by 10 percent. Improvements in pulping technology could increase woodpulp yields and lead to the production of more pulp from hardwoods and wastepaper.

There are numerous other ways to extend timber supplies. For instance, with improved design, equally serviceable and attractive structures and products could be produced with less wood. Lengthening the service life of wood structures and products would also extend supplies. This longer life could be achieved through better design and improved maintenance. Longer life also could be attained by chemically treating timber for added resistance to decay, fire, and insects.

Many of the opportunities to increase and extend timber supplies are technically and economically feasible. And they can be realized while maintaining the forest environment. However, substantial progress toward



Sustaining increased harvests on the National Forests, on southern pine forests and on the eastern hardwood forests, will require large investments in regeneration and related management programs to increase timber growth.

using these opportunities will require large investments in a variety of management, research, and assistance programs.

Many of the opportunities to increase timber growth are on lands in private ownerships, which collectively contain nearly three-quarters of the Nation's commercial timberlands. The owners of these lands have widely

varied attitudes and objectives, and most have only limited knowledge of management possibilities. Many see little benefit from investments to grow more timber because they may not own the land long enough to profit from selling. And they differ a great deal in final capabilities to make investments that will increase timber supplies. Ways need to be developed for overcoming these obstacles.

There are also large opportunities on the public ownerships. For example, the potential net annual growth in 2030 on the National Forests is nearly double that of today. Management policies for realizing these opportunities need to be firmly pursued.

Much more could be done to increase and extend timber supplies using existing methods. Research to develop new and improved technologies, however, could add in major ways to the productivity of timberlands and to meeting increased demands for timber products.

Inevitably, as management programs are expanded to meet growing demands for timber, the forests will be enhanced for some uses. There would also be increasing conflicts among the various uses of the forest. Research is the best hope of developing more

effective ways of managing forest resources to maximize outputs and reduce conflicts among uses.

In addition, research is needed to further explore the social, economic, and environmental implications of a future in which the demands for timber are likely to rise more rapidly than supplies. The results of this research will provide our society with the bases for guiding forest policies and programs.

Moving forward to meet the Nation's growing demands for timber and timber products will require large investments in management, assistance, and research programs. The partial analyses that have been made indicate that when the social, economic, and environmental benefits are considered, these investments are likely to be profitable from the standpoint of the society and the economy.

